MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

DMT5018 – MICROCONTROLLER TECHNOLOGY

(Diploma in Electronic Engineering)

5 MARCH 2018
2:30 PM – 4:30 PM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **7** pages (**4** pages with **4** questions and **3** pages for appendix).

2. Answer **ALL** questions. All necessary working steps must be shown.

3. Write all your answers in the answer booklet provided.

QUESTION 1 [25 Marks]

a) Define system bus and briefly describe three of its common functional group.

[4 marks]

b) Describe the process of memory **read** operation. Provide suitable illustration(s) to support your description.

[9 marks]

c) Based on the assembly language instructions below, answer the following questions:

```
          ORG 0050H
Line 1    MOV PSW, #18H
Line 2    MOV R1, #0A3H
Line 3    MOV R2, #57H
Line 4    MOV A, #91H
Line 5    MOV R3, #0F5H
Line 6    ADD A, R2
Line 7    MOV B, #10H
Line 8    MUL AB
          END
```

(i) Which register bank is currently used?

[1 mark]

(ii) After performing the instruction at **line 6**, what is the content of Carry Flag, Auxiliary Flag, Overflow Flag, Parity Flag, Accumulator and Program Status Word register?

[8 marks]

(iii) What is the content of Accumulator and B after executing the instruction at **line 8**? Verify whether the OV flag is set or cleared and justify your reason.

[3 marks]

Continued...

QUESTION 2 [25 Marks]

Based on the given assembly language program at Table 1, answer the following questions:

Address	Line	Label	Instruction	Opcode	Addressing Mode	Instruction Type
			ORG 0000H			
0000	1		MOV R1,#0AH	(i)	(vi)	
0002	2	HERE:	MOV @R1,#00H	(ii)		
0004	3		INC R1	(iii)		
0005	4		NOP			
0006	5		MOV A, R1	(iv)	(vii)	
0007	6		CJNE R1,#35H,HERE		(viii)	(ix)
000A	7		SWAP A	(v)		(x)
			END			

Table 1

a) Complete the answer for the cells marked with roman numbers starting from (i) to (x).
[10 marks]

b) Find the opcode of the instruction at line 6. Please include your working step on finding the offset for the instruction at line 6.
[3 marks]

c) Calculate the total execution time of the program. The crystal frequency used is set to be 12 MHz.
[5 marks]

d) What is the content of the Accumulator and register R1 after executing the program?
[2 marks]

e) Reconstruct the assembly language program based on the given machine code at Table 2 below and state the final content of each of the affected memory locations. Include any proper labels if necessary.

Line	Opcode
1	78H 05H
2	79H 25H
3	09H
4	D8H FDH

Table 2

[5 marks]

Continued...

QUESTION 3 [25 Marks]

a) Construct an assembly language program to continuously monitor both motion sensor and infrared sensor connected to P2.5 and P2.6 respectively. A buzzer at P1.5 will turn ON for 0.5 seconds if the motion sensor is momentarily LOW, while an LED at P1.6 will turn ON for 0.5 seconds if the infrared sensor is momentarily LOW. If **both** sensors are LOW at the same time, always service and give priority to the motion sensor.

Use Timer 0 to provide delay for both buzzer and LED. Assume the crystal frequency used is 12 MHz. Note that the sensors, buzzer and LED are all set to be **active LOW**. **Do not use interrupt** and the working steps for calculation of timer reload value must be shown.

[15 marks]

b) Construct an assembly language program to continuously transmit the phrase "OVERFLOW" through serial port at 4800 bauds, whenever the infrared sensor connected to pin P2.6 is turned ON (Active LOW). Assume the crystal frequency used is 11.0592 MHz and the value of SMOD = 0. The working steps to calculate TH1 must be shown.

[10 marks]

Continued...

QUESTION 4 [25 Marks]

a) Briefly show the steps involved in interrupt processing.

[8 marks]

b) How to enable both serial port interrupt and external interrupt 1?

[1 mark]

c) Construct an assembly language program for the following requirements:

- A common anode 7-segment display is connected to P1 of an 8051 microcontroller. Turn ON the 7-segment display with character 'E', whenever the external interrupt $\overline{INT0}$ of pin P3.2 is LOW. Otherwise, turn OFF the 7-segment display.

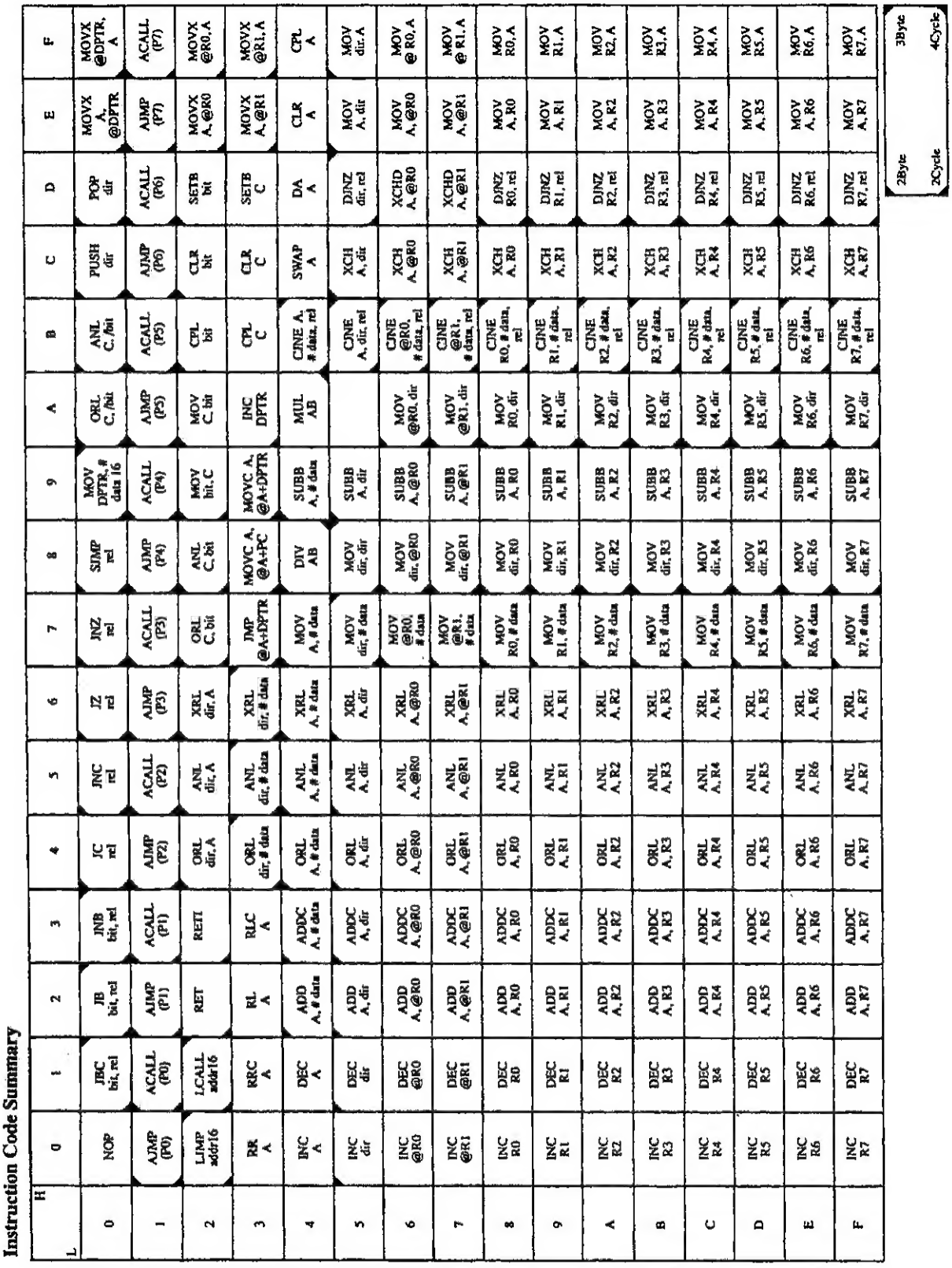
- Right after the 7-segment display is turned OFF, the program must turn ON an LED 1 (Active LOW) connected to P1.5, for at least 20 milliseconds. The program should be able to repeat itself afterwards.

Apply edge-triggering to the external interrupt $\overline{INT0}$. Apply Timer 1 for the delay and assume 12MHz crystal frequency is used.

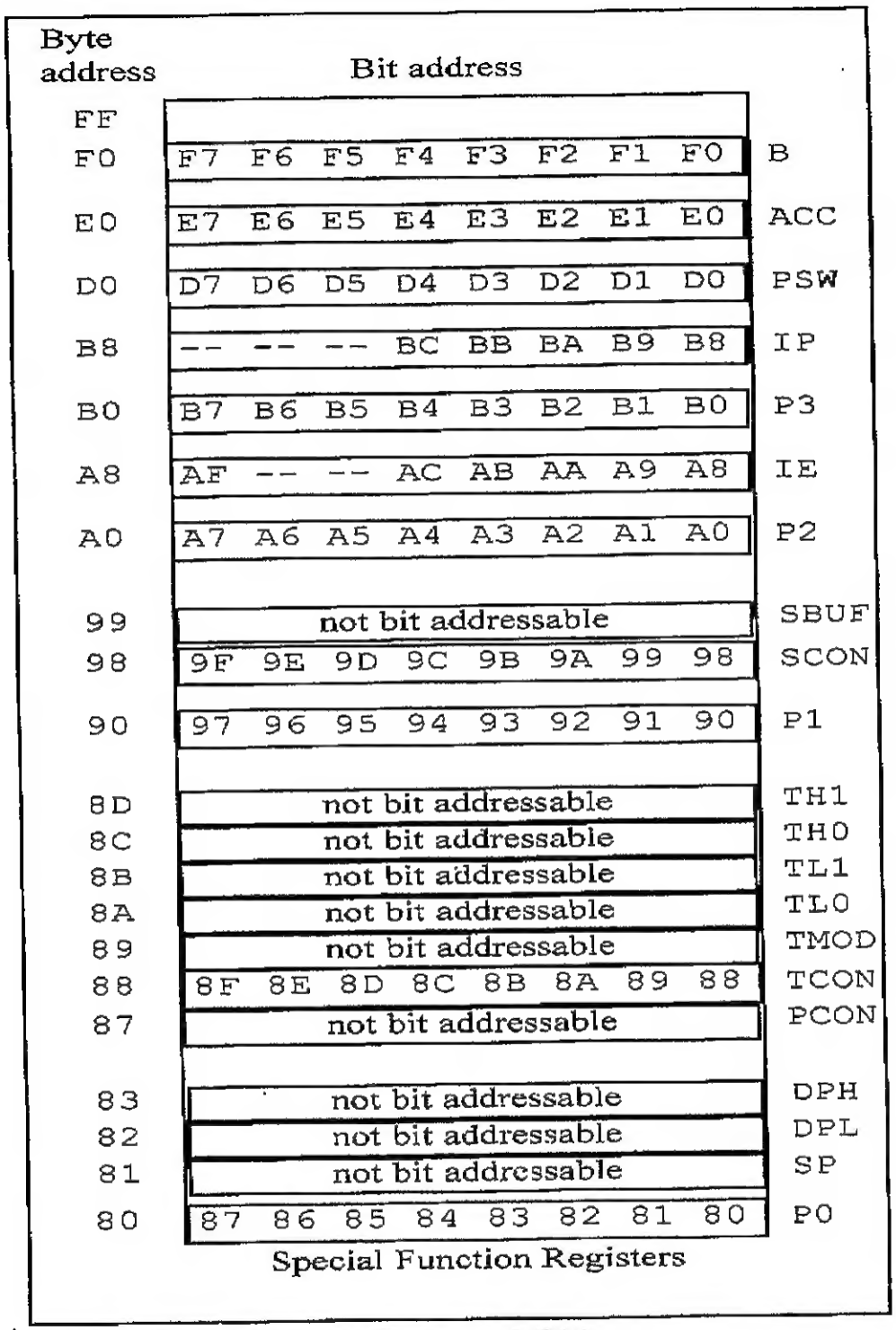
[16 marks]

End of Page.

APPENDIX A: OPCODE MAP



APPENDIX B: 8051 SPECIAL FUNCTION REGISTER (SFR)



SFR RAM Address (Byte and Bit)

APPENDIX C: BIT-ADDRESSABLE RAM LOCATIONS

Byte Address	Bit Address							
2F	7F	7E	7D	7C	7B	7A	79	78
2E	77	76	75	74	73	72	71	70
2D	6F	6E	6D	6C	6B	6A	69	68
2C	67	66	65	64	63	62	61	60
2B	5F	5E	5D	5C	5B	5A	59	58
2A	57	56	55	54	53	52	51	50
29	4F	4E	4D	4C	4B	4A	49	48
28	47	46	45	44	43	42	41	40
27	3F	3E	3D	3C	3B	3A	39	38
26	37	36	35	34	33	32	31	30
25	2F	2E	2D	2C	2B	2A	29	28
24	27	26	25	24	23	22	21	20
23	1F	1E	1D	1C	1B	1A	19	18
22	17	16	15	14	13	12	11	10
21	0F	0E	0D	0C	0B	0A	09	08
20	07	06	05	04	03	02	01	00

APPENDIX D: PROGRAM STATUS WORD (PSW)

CY	AC	F0	RS1	RS0	OV	--	P

APPENDIX E: TIMER/COUNTER MODE CONTROL (TMOD) REGISTER

G	C/T	M1	M0	G	C/T	M1	M0

APPENDIX F: SERIAL CONTROL (SCON) REGISTER

SM0	SM1	SM2	REN	TB8	RB8	TI	RI

APPENDIX G: INTERRUPT ENABLE (IE) REGISTER

EA	--	ET2	ES	ET1	EX1	ET0	EX0

APPENDIX H: INTERRUPT PRIORITY (IP) REGISTER

--	--	PT2	PS	PT1	PX1	PT0	PX0